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Coronary Angioplasty for Elderly Patients With "High Risk" Unstable Angina: Short-Term Outcomes and Long-Term Survival

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Objectives. **We sought to compare the short- and long-term mortality rates in patients ≥70 years old with unstable angina undergoing percutaneous transluminal coronary angioplasty (PTCA) with predicted coronary artery bypass graft surgery (CABG) short-term and U.S. census long-term mortality rates.**

Background. **Coronary angioplasty is an alternative revascularization strategy for patients with medically refractory rest angina and a high risk of adverse outcomes with CABG. Patients ≥70 years old are a specific high risk subset.**

Methods. **A total of 131 consecutive patients aged ≥70 years with unstable angina underwent PTCA; 82 (62%) of 131 had been refused CABG. Mortality over time was obtained from the Veterans Affairs Beneficiary Index Records Locator Subsystem. Predicted 30-day CABG-associated mortality was obtained from the Veterans Affairs Cardiac Risk Assessment Model. Mortality over time was expressed with Kaplan-Meier curves.**

Results. **The observed 30-day angioplasty survival rate was 87% compared with the predicted surgical 30-day survival rate of 85.5%. In those patients who survived 6 months after angioplasty (84%), their subsequent 1-, 2-, 3-, 4- and 5-year survival rates were comparable to age-matched subjects in the U.S. census. Mortality in certain subsets known to be at very high risk for CABG—for example, patients who had a previous CABG—was not high in this cohort of elderly subjects. The extremely high risk subsets identified in this PTCA cohort (shock, heart failure, pressors required, balloon pump required) were relatively infrequent subsets.**

Conclusions. **For selected elderly patients with unstable angina deemed to be at "high risk" or even "prohibitive risk" for CABG, PTCA is an alternative revascularization strategy. The long-term mortality of successfully treated elderly patients is comparable to age-matched subjects. A prospective, multicenter, randomized trial of CABG versus PTCA, which includes patients ≥70 years old, is being conducted (Veterans Affairs Cooperative Study 385: AWESOME).**

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Unsuccessful revascularization and adverse outcomes are more frequent with either coronary artery bypass graft surgery (CABG) or percutaneous transluminal coronary angioplasty (PTCA) for patients >70 years of age compared with younger patients (1–34). Furthermore, because the prevalence of symptomatic coronary artery disease increases with age and because the U.S. population is aging, both CABG and PTCA procedures are being used in larger numbers in patients >70 years of age (1). Many patients undergoing CABG or PTCA have additional clinical risk factors, such as acute infarction, or anatomic risk factors, such as diffuse disease, which are associated with even higher rates of adverse outcomes and mortality (35–42). Despite these facts, recent data suggest that outcomes using these two procedures are improving over time (1). This report analyzes survival based on a single center's retrospective, consecutive case review of PTCA used to treat unstable angina in patients ≥70 years old and identifies clinical and angiographic predictors of procedural mortality. Short-term (30 days) mortality with PTCA is compared with predicted surgical mortality, and long-term (1 to 5 years) mortality is compared with U.S. census figures. These data are used to extend the hypothesis that PTCA provides an alternative revascularization strategy for unstable ischemia patients who are at "high risk" or "prohibitive risk" for CABG-associated mortality (35,36), specifically the elderly subset. This hypothesis is being tested prospectively in a 14-center Veterans Affairs cooperative trial of PTCA versus CABG, which includes patients ≥70 years of age (AWESOME).

Methods

The catheterization records of patients undergoing PTCA between January 1987 and December 1994 were reviewed to identify all patients ≥70 years of age. Indications for the procedure were reviewed to identify all patients with unstable angina. The study group consists of the 131 patients (12.8% of total PTCAs performed during this period) meeting these two criteria. Records were further reviewed to identify the presence of remote myocardial infarction or recent (within past 7 days) infarction; whether the patient came to the laboratory while taking digoxin, diuretics or intravenous nitroglycerin or

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Abbreviations and Acronyms

CABG = coronary artery bypass graft surgery
ECG = electrocardiogram, electrocardiographic
PTCA = percutaneous transluminal coronary angioplasty

with an intra-aortic balloon pump; whether the patient had a previous CABG; left ventricular ejection fraction; the presence of heart failure or shock; creatinine; the presence of chronic obstructive pulmonary disease; cardiomegaly on chest X-ray film; the presence of peripheral vascular disease; rest electrocardiographic (ECG) changes with pain; anginal functional class; American Society of Anesthesia functional class; and PTCA priority (elective, urgent or emergent). In this report and all previous reports from our institution, we use the term "salvage angioplasty" to mean PTCA that was undertaken in an attempt to relieve "medically refractory" rest angina in a patient who was refused CABG by our cardiac surgeons based on their perception of "prohibitive risk" of CABG-associated operative mortality (39,40). Patients may also be refused CABG based on the perception of minimal gain from CABG relative to its risk. "High risk" for CABG is based on a greater than twofold increase over baseline in operative mortality and/or a univariate risk >7% in 30-day CABG mortality, as ascertained in the 45-hospital VA Surgical Registry data (15). Defined in this manner, "high risk" does not include the contributions to CABG risk of diffuse coronary artery disease or poor distal targets for CABG or the contributions of a number of significant comorbidities such as liver disease or cancer. For patients who are refused CABG and those classified as "high risk" but not refused CABG patients, PTCA was performed without surgical standby. Hospital records were reviewed to determine hospital discharge versus in-hospital mortality. Data on postoperative deaths were also obtained from the Beneficiary Identification Records Locator System file (36).

Using the Veterans Affairs Risk Assessment for Cardiac Surgery multivariate logistic regression analysis of 12 variables, a predicted 30-day operative mortality was calculated (15). The 12 variables used in this analysis are age, serum creatinine, history of chronic obstructive pulmonary disease, cardiomegaly, previous heart surgery, peripheral vascular disease, rest ST segment changes on ECG, angina functional class, preprocedure intra-aortic balloon pump, current digoxin use, American Society of Anesthesia functional class and procedural priority (elective, urgent or emergent).

Results

Preprocedural variables. As shown in Table 1, all 131 patients in this series were ≥70 years old and had unstable angina—66% had rest angina, 40% demonstrated reversible ECG changes and 16% had a left ventricular ejection fraction ≤0.35. Additional risk factors for adverse outcomes with CABG, as identified in the Veterans Affairs Cardiac Surgery Risk Assessment program are as listed in Table 1.

Table 1. Clinical Characteristics of 131 Study Patients

Unstable angina	131 (100%)
Rest angina	87 (66%)
Reversible ECG changes	52 (40%)
MI within 7 days	54 (41%)
Preprocedure heart failure	15 (11%)
Preprocedure shock	6 (5%)
LVEF ≤0.35	16/100 measured
3-vessel disease	61 (47%)
Prior CABG	57 (44%)
COPD	14 (11%)
Peripheral vascular disease	13 (10%)
Cerebrovascular disease	10 (8%)
Creatinine >2.0 mg/dl	8 (6%)
Diabetes	23 (18%)

Data presented are number (%) of patients, unless otherwise indicated. Cerebrovascular disease = previous cerebrovascular accident; COPD = chronic obstructive pulmonary disease; Diabetes = diabetes requiring insulin or oral agents; Heart failure = dyspnea, rales, chest radiographic changes of fluid or dyspnea plus elevated wedge pressure; LVEF = left ventricular ejection fraction; MI = myocardial infarction; Peripheral vascular disease = peripheral vascular operation; Prior CABG = at least one coronary artery bypass graft (CABG) operation; Rest angina = symptoms at rest; Reversible ECG changes = electrocardiographic (ECG) T wave inversion on ST segment depression or elevation that occurred with symptoms and were resolved with treatment; Shock = altered mental status or reduced urinary output with blood pressure <90 mm Hg and wedge pressure >18 mm Hg; Unstable angina = rest or new-onset angina or increasing frequency of angina; 3-vessel = ≥70% lumen narrowing of left anterior descending coronary artery and circumflex major branch and posterior descending coronary artery.

Significant comorbidities included chronic obstructive pulmonary disease (forced expiratory volume in 1 s <1.5 liter or home oxygen dependent, or both) in 11%; peripheral vascular disease (after the operation) in 10%; cerebrovascular disease (previous stroke or surgical procedure, or both) in 8%; renal failure (creatinine >2.0 mg/dl or dialysis required, or both) in 6%; and diabetes (insulin-requiring and end-organ damage) in 18%.

Angiographic variables predictive of adverse outcomes with PTCA included angiographic thrombus in 34 (20%) of 174 vessels, length of diseased segment >2 cm in 50 (29%) of 174 vessels, and occlusion in 27 (16%) of 174 vessels.

Using the latest Veterans Affairs Cardiac Surgical Risk Assessment Model, the mean predicted CABG 30-day mortality rate for these patients was 14%, comparable to the observed 30-day PTCA mortality rate of 13%.

Procedural variables. As shown in Table 2, PTCA was attempted in 174 vessels: 90 patients had single-vessel PTCA, 39 patients had two-vessel PTCA attempted (78) and 2 patients had three-vessel PTCA attempted (6). The distribution of vessels is listed in Table 2. Reduction of lesion stenosis to <50% was accomplished in 150 vessels (86%).

Short-term clinical outcomes are listed in Table 3. All in-hospital deaths are included in the failure category, although five patients who died during the index hospital period

Table 2. Angiographic Results of Coronary Angioplasty in Elderly Patients With Unstable Angina

	No. of Vessels*
No. of vessels attempted	
1 (90 pts)	90
2 (39 pts)	78
3 (2 pts)	6
Total	174
Vessel attempted	
LAD	49
Diag	10
Cx-OM	40
LMCA	9
RCA	37
SVG	29
Angiographic result	
<50% (success)	150 (86%)
>50% residual stenosis (failure)	24 (14%)

*Can include tandem lesions or diffuse disease within one major coronary artery. Cx-OM = circumflex coronary artery or obtuse marginal branch; Diag = diagonal branch of left anterior descending coronary artery; LAD = left anterior descending coronary artery; LMCA = left main coronary artery; pts = patients; RCA = right coronary artery; SVG = saphenous vein graft.

had angiographically successful PTCA (four patients with shock died in low output state, and one septic patient died from septic shock). The clinical success rate (angiographic success plus no major complication) was 79% (102 of 131 patients).

Survival data. Survival was based on Kaplan-Meier estimates. Table 4 presents longer term survival through 5 years. Early mortality was derived from hospital records. Longer term mortality was based on deaths recorded in the Beneficiary Index Records Locator Subsystem data base. Mortality fell into three periods: a very high period through 1 month, a high period through 6 months and a low, stable period from 6 months through 5 years. Data are too sparse to estimate survival beyond 5 years. Survival after 6 months is approximately exponential with an average annual survival of 97%.

Table 4 presents yearly survival estimates for patients who survived at least 6 months after PTCA. These rates are obtained by dividing the 1-, 2-, 3-, 4-, and 5-year survival rates by the 6-month figure. These figures are compared with the 5-year survival (65 to 70 and 70 to 75 years) rates for the U.S. population. Survival rates for the patients aged ≥70 years who had PTCA and survived to 6 months are between the rates of the 65 to 70-year age group and the 70 to 75-year age group. The average annual survival rate for the 6-month survivors is the same as that for the 65 to 70-year period for the U.S. population (97%), and a bit higher than their census age cohorts (95%).

Table 3. Short-Term Clinical Outcomes

Angiographic success	150/174 (86%)
Clinical success	102/131 (79%)
In-hospital deaths	15 (11%)
Emergency CABG	0
Urgent CABG	1 (<1%)
Hospital discharge	116 (89%)
Improvement in angina	116 (89%)

Data presented are number (%) of patients, unless otherwise indicated. Angiographic success = <50% diameter residual stenosis [number (%) of vessels]; Clinical success = angiographic success in at least one artery plus relief of angina plus no major complication (death, myocardial infarction, emergent or urgent CABG); Emergency CABG = coronary artery bypass graft surgery (CABG) within 1 h of failed angioplasty; Hospital discharge = discharge from index hospital period; Improvement in angina = at least one Canadian Cardiovascular Society class; Urgent CABG = CABG during same hospital period as angioplasty.

Table 4. Kaplan-Meier Survival Estimates for Denver High Risk Patients Treated With Coronary Angioplasty for Unstable Angina

	K-M Survival		U.S. 5-yr Survival Rate	
Time After PTCA	After PTCA (%)	6 mo (%)	Age 65–70 yr (%)	Age 70–75 yr (%)
1 mo	87			
6 mo	84	100	100	100
1 yr	81	97	98	97
2 yr	77	94	95	92
3 yr	77	89	92	87
4 yr	76	89	88	82
5 yr	74	87	85	78
Mean yearly survival from mo 6 to yr 5*		97	97	95

*Estimated by linear regression of log(Kaplan-Meier [K-M] survival estimate) on time. PTCA = percutaneous transluminal coronary angioplasty.

Failed PTCA in an elderly high risk cohort. Table 5 presents clinical and angiographic data on the 28 patients in whom PTCA failed in this series. Clinically, 21 (75%) of 28 experienced failure within 7 days of an acute infarction; 6 (21%) of 28 were in cardiogenic shock; 7 (25%) of 28 had congestive heart failure before PTCA; 5 (18%) of 28 had a left ventricular ejection fraction ≤0.35; and 5 (18%) of 28 were taking pressor drugs. Anatomically, 17 (50%) of 34 vessels attempted in this group were occlusions, and 16 (47%) of 34 vessels had an angiographic clot. In terms of outcomes, 3 (100%) of 3 cases complicated by distal embolization were fatal; 2 (40%) of 5 acute occlusive syndromes in this cohort were fatal; and the one "no-reflow" in this series was complicated by a nonfatal infarction.

Discussion

This study reports on the outcomes of PTCA used to treat medically resistant unstable angina in patients ≥70 years of age in a logistically strained and conservative therapeutic environment. One significance of the environment is that patients who will undergo PTCA for unstable angina in our hospital have high prevalences of clinical and angiographic variables predictive of adverse outcomes. Nevertheless, over 80% of the patients at the Denver Veterans Affairs Medical Center aged ≥70 years with unstable angina survived to 6 months after PTCA. These results compare favorably with the short-term

Table 5. Clinical Failure of Attempted Coronary Angioplasty in 28 (21%) of 131 Elderly Patients With Unstable Angina

Pt No./ Age (yr)	Clinical Setting	Comorbid Disease	CAD	Clot	% Diam Sten Pre/Post Intervention	Outcome
		In-Hospital Deaths (15 [11%] of 131)				
1/74	MI, CHF, LVEF 0.25	Dementia	LAD	×	95/100	MI
			RCA		100/30	
2/71	MI, shock, IABP, pressors		LAD	×	70/30	24-h low CO
3/77	MI, shock, IABP, pressors		LAD	×	100/50	24-h low CO
4/73	MI, shock, IABP, pressors		LAD	×	100/100	
			RCA	×	100/100	
5/73	MI, shock, IABP, post-CABG, renal		LMCA		90/70	24-h low CO
			Cx-OM		100/50	
6/76	MI, CHF, shock, IABP, MI		LAD	×	100/100	
			LAD		95/40	
7/73	MI, hemodynamic, IABP, post-CABG, diabetes, renal		Diag	×	95/100	2nd PTCA
8/76	MI, prior CABG, diabetes		SVG-LAD		95/50	Embolization
9/70	MI		LAD	×	100/50	Embolization
10/82	MI, CHF, prior CABG		LAD	×	100/100	
11/80	MI, CHF, prior CABG, COPD, renal		SVG-LAD		95/60	
12/80	AVR, sepsis, CHF, anemia, unstable angina		Cx-OM		90/40	24-h sepsis
13/74	MI		LAD	×	95/50	Embolization
14/72	LVEF 0.30, prior CABG, dialysis, PVD		Cx-OM	×	95/95	
15/70	MI, CHF, shock, pressors		RCA	×	100/20	48-h low CO
		Nonfatal Failures (13 [10%] of 131)				
16/70	CVD/PVD		RCA		90/100	Abrupt occlusion
17/74	MI, CHF, LVEF 0.29	Diabetes	LAD		90/100	Abrupt occlusion
			RCA		100/100	
18/70	MI, LVEF 0.35	PVD, dialysis	Cx-OM		100/100	
19/74	MI, PVD, cancer	RCA, cancer	RCA		100/100	
20/74	Prior CABG	Syncope	RCA	×	100/100	
21/75		Diabetes	Cx-OM		95/95	
22/70	MI, LVEF 0.37	Alcohol	RCA		90/100	
23/75			RCA	×	100/100	
24/77			Cx-OM		95/100	
25/70			RCA	×	100/100	
26/74	Prior CABG		Cx-OM		100/100	
			RCA		100/100	
27/70	MI, LVEF 0.35	Dialysis	Cx-OM		100/100	
28/78	MI, prior CABG	Cancer	SVG-RCA	×	95/40	No reflow

AVR = aortic valve replacement; CHF = congestive heart failure (tachypnea, rales, arterial desaturation, chest X-ray findings consistent with pulmonary edema); Clot = angiographic clot; CO = cardiac output; CVD = cerebrovascular disease (surgery or stroke); Hemodynamic = hemodynamic compromised (blood pressure <90 mm Hg systolic with pulmonary pressure wedge >12 mm Hg without shock signs); IABP = intraaortic balloon pump placed for hemodynamic reasons; pressors = dopamine, dobutamine; PVD = peripheral vascular disease (after operation); Pt = patient; renal = creatinine >2.0 mg/dl or dialysis required, or both; Shock = cardiogenic shock (includes blood pressure <80 m systolic with pulmonary wedge >18 and shock signs); % Diam Sten = percent diameter stenosis; other abbreviations as in Tables 1 and 2.

predicted CABG survival rates in a cohort of sufficient risk, nearly two-thirds of whom had been refused CABG. The 6-month survivors had a subsequent 5-year survival record that was at least as good as that of the average population. These results suggest that PTCA is a viable option for many elderly patients with unstable angina who are at "high risk" and even at "prohibitive risk" for surgical revascularization.

Bypass graft surgery in the elderly. A large number of retrospective, consecutive case series support the use of CABG in patients ≥70 years old. Most series report relief of symptoms in nearly 90% of patients, but all are in agreement that short-term mortality is greater in patients ≥70 years old than in younger patients (2–15). Within the entire population of elderly patients with symptomatic ischemic disease, subsets with recent infarction, hemodynamic compromise, severely impaired left ventricular function, prior CABG, significant comorbidity and diffuse coronary disease all have even higher rates of mortality and morbidity; such patients are said to be at "high risk" for CABG (15). At some level of risk, patients are refused CABG based on the perception of "prohibitive risk"

(35). For selected "high risk" and "prohibitive risk" patients, PTCA may be an alternative revascularization method (35,36).

Coronary angioplasty. A number of retrospective, consecutive case series support the use of PTCA for treating unstable myocardial ischemia in patients ≥70 years old (16–37). Success rates appear to be comparable to those obtained in patients <70 years old, but reported incidences of complicating infarction, emergency CABG and hospital mortality are all higher (16–37). Because these are series of selected patients, no comparison between PTCA and CABG can be drawn from these data.

We have been using PTCA to treat patients specifically refused CABG (salvage angioplasty) for 8 years (39,40). Age ≥70 years is a specific "high risk" factor from the Veterans Affairs Surgical Registry, and accordingly, all 131 of these patients were considered "high risk" for CABG; 82 (62%) of the 131 patients had been specifically refused CABG by our surgeons (15).

The use of PTCA as an alternative is being prospectively tested in Veterans Affairs Cooperative 385—Angina With Extremely Serious Operative Mortality Evaluation (AWESOME). Patients who are accepted for CABG by surgeons at the 14 participating hospitals are being randomized to either CABG or PTCA, and patients refused CABG and patients who refuse to be randomized are also being prospectively followed in separate registries. From these data it will be possible to identify specific cohorts for which PTCA or CABG is preferable in terms of short- and long-term mortalities, repeat revascularizations and symptoms.

Conclusions. The Denver Veterans Affairs PTCA experience with elderly, high risk patients with unstable angina demonstrates the following: 1) The observed 30-day PTCA survival rate of 87% compares favorably with a predicted 30-day CABG survival based on the Veterans Affairs Cardiac Surgery Risk Assessment Model of 86%. 2) For those 84% of elderly, high risk patients with unstable angina who survived 6 months after PTCA, their subsequent 1- to 5-year survival rates are comparable to ≥70-year olds from the U.S. census. 3) Previous CABG, which accords a high risk to ≥70-year olds with unstable angina for repeat CABG, does not greatly increase the risk for PTCA. 4) The highest risk factors in this cohort for PTCA (shock, pressors on laboratory entry, prior ventricular fibrillation and heart failure) were relatively infrequent. Accordingly, even if these factors were considered "prohibitive risk," most elderly patients with unstable angina might be considered for the PTCA option.

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